

# WOUNDS AND THEIR MANAGEMENT




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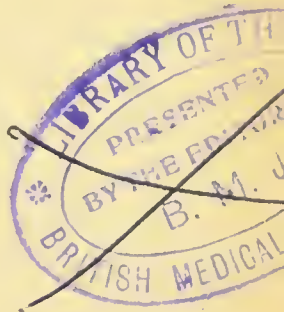
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# WOUNDS AND THEIR MANAGEMENT



BY

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HANDBOOK OF MIDWIFERY"; "EXAMINATION OF  
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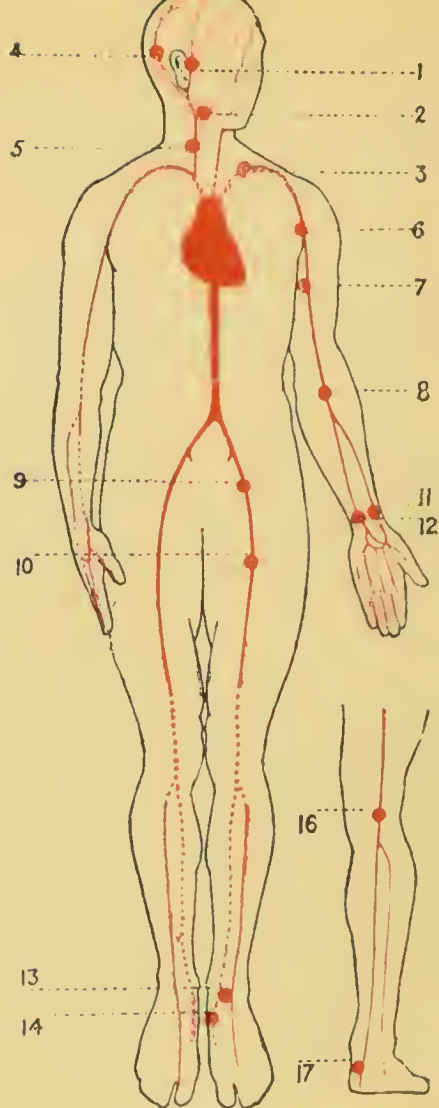


Diagram showing the main arteries of the body and the points where pressure should be made to arrest hæmorrhage.

1. Temporal, 2. Facial, 3. Subclavian, 4. Occipital, 5. Carotids, 6. Axillary, 7., 8. Brachial, 9. Iliac, 10. Femoral, 11. Radial, 12. Ulnar, 13. Anterior Tibial, 14. and 17. Posterior Tibial, 16. Popliteal.

# WOUNDS AND THEIR MANAGEMENT.

## CHAPTER I.

Definition of wound—Classification of wounds—Incised wounds—Lacerated wounds—Contused wounds—Ecchymosis—Punctured wounds—Gunshot wounds—Poisoned wounds.

THE term “wound,” in its surgical sense, signifies a break in the continuity of the skin or mucous membrane arising from some mechanical force such as an accident or the surgeon’s knife. But, in a wider sense, it may be taken to include a break in the continuity of any of the tissues of the body, even where the skin remains intact. Such a definition would include a contusion, where the soft parts underlying the skin are lacerated, or a simple fracture ; but

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we shall content ourselves with the narrower, surgical definition. The terms of our definition will exclude certain ulcers or open sores where the condition of mechanical force is non-existent.

Wounds are classified according to the condition of their edges and general character ; for example : incised wounds, lacerated wounds, contused wounds and punctured wounds. Again, we speak of certain varieties of wounds such as gun-shot wounds, perforating wounds and penetrating wounds. But the most important classification from the surgeon's point of view depends on whether a wound is infected or the reverse.

It will be most convenient to commence our description of wounds by adopting the first-named classification.

Incised wounds are generally produced by a sharp instrument such as a knife or a piece of glass, but not always so ; for a fall or a blow

from a blunt instrument, especially when the skin is tightly stretched over an underlying bone, with little subcutaneous tissue interposing, may produce an injury having all the characters of an incised wound.

The edges of such a wound are clean-cut and are apt to gape according to the degree of elasticity of the parts involved. There is an absence of bruising. Hæmorrhage is apt to be free owing to the vessels being sharply and cleanly cut through. The amount of hæmorrhage depends on the number and size of the vessels divided and the rapidity with which the divided ends retract and close. Incised wounds are usually painful.

Lacerated wounds are caused by blunt objects, by machinery, etc. The tissues are more or less extensively torn, the edges of the wound are irregular and bruised and do not gape so much as in the case of an incised wound. The hæmorrhage is generally slight, as the vessels are

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torn rather than cut and their coats twisted, this favouring the closing of the vessels. Lacerated wounds are especially liable to such complications as profuse suppuration and the various forms of blood-poisoning.

Contused wounds present characters very similar to lacerated wounds, but there is, in addition, bruising of the surrounding and underlying tissues, the result of their infiltration with the blood poured out from the torn vessels. Such bruising is scientifically known as ecchymosis. It generally shows itself at once in the case of wounds involving superficial parts only and where the tissues are lax and yielding : but where the injury involves deeper seated tissues the discoloration of the skin may take some days to show itself. The typical blue discoloration of superficial bruising does not develop immediately, and continues, it may be, for six hours. The colour gradually changes from a deep blue to green and yellow, the change



beginning at the edge and passing in towards the centre. The amount of bruising depends on the severity of the injury, the degree of force used, the part of the body involved, and the age and state of health of the patient. A man in good physical condition may have almost no sign of bruising around a severe wound, whereas the same injury in a man in poor health would produce considerable ecchymosis. The slightest injury in a patient the subject of scurvy will produce bruising. This is especially well marked in children the subjects of scurvy.

Punctured wounds may be very slight, such as those produced by a needle or splinter; or they may be caused by a sword or bayonet and rapidly prove fatal. The superficial or external opening in the case of a penetrating wound may be very small, but the damage to deep structures may be considerable or irreparable. Large blood-vessels, nerve trunks, the body cavities or viscera may be involved. The tendency to

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hæmorrhage in these wounds is to be internal rather than external. It is in this class of injuries that infection of the wound is so dangerous.

Gunshot wounds obviously vary in their character according to the nature of the weapon used, the kind of projectile, its velocity and the distance from which it is fired; the shorter the range the greater is the amount of injury. Such wounds may simply involve the flesh or may cause extensive damage to bones, blood-vessels, nerves and viscera. In merely flesh wounds the bleeding is not usually severe. But there may be serious internal hæmorrhage from the involvement of one of the large blood-vessels which may rapidly prove fatal unless the vessel can be controlled. The entrance wound is small and the exit wound slightly larger. Sometimes a hole may be drilled in a bone by a bullet, but more often there is splintering of the bone causing the wound to be complicated by a commin-

uted fracture with its consequent risk of sepsis. Bullets which lodge in the body are frequently deflected in their course by coming in contact with a bone or other rigid structure. For example, a bullet entering the cheek may lodge in the back of the neck. It has been shown that a revolver bullet fired close to the body may produce a large lacerated wound or simply a round hole or a slit. If fired within three or four feet the skin may be scorched or the clothes singed. Treves has shown that the mortality of abdominal gun-shot wounds has been reduced from 90 per cent (American Civil War) to 40 per cent (South African War), and that without operation. This is owing to the modern bullet travelling straight and direct instead of being deflected as used to be the case when the old rifles were used.

Under the head of poisoned wounds may be mentioned insect stings, the bites of animals such as snakes, and wounds occurring during post-mortem examinations.

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Insect bites are more irritating than actually dangerous, but a sting, for example of the tongue or in the mouth, may cause a rapid and alarming swelling of the affected part (œdema). Some insect bites are of a virulent nature and may set up severe local inflammation. It must be remembered, too, that it is by means of a species of mosquito (the anopheles) that malaria is conveyed.

Snake bites in this country are rare. The poison is conveyed from glands in the upper jaw through fine channels in the special teeth. The bite of the common adder is seldom fatal. It is followed in about an hour by collapse, vomiting, pain and swelling in the affected part.

Post-mortem wounds and accidental wounds produced at the time of a surgical operation in septic cases may be of the greatest gravity, and have caused the death of many medical men. The bodies of those dying of septic affections are highly virulent shortly before death, and the

greatest care is requisite when performing a post-mortem examination in such cases to prevent the skin being scratched or cut. The use of rubber gloves nowadays tends to lessen the risk of such calamities.

## CHAPTER II.

The method of repair of wounds—Healing by first intention or primary union—Healing by granulations—Suppuration.

WE have now to study the methods of healing of wounds. The process is essentially the same in all kinds of wounds; but it is modified according to the variety of wound with which we have to deal, and according to the state of the wound; for example, according as it is kept aseptic and well-drained or the reverse.

We shall commence with a brief account of the healing process in the case of an incised wound in a healthy subject. There will be more or less free hæmorrhage according to the size of the blood-vessels cut. The blood may spout up in

jets when a fair sized artery is divided or it may well up into the wound in the case of venous hæmorrhage; or, again, there may be merely a general oozing in cases where only the capillaries are involved. After the hæmorrhage has ceased or has been arrested and the edges of the wound have been brought together (we are presuming that no drainage is required) and dressed, if asepsis has been secured and maintained, the wound will heal without the formation of matter (pus) by a process akin to that which happens in an inflamed part. We say "primary union," or "union by first intention" has taken place. This is always what the surgeon aims at in his operation wound, and it is the ideal form of healing. Now, we may study this process a little more in detail. As soon as the hæmorrhage has stopped, the mouths of the divided vessels become filled with blood-clot while the blood-vessels nearest to those which have been divided dilate; this comes about partly as a re-



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sult of the blocking of the vessels beyond and

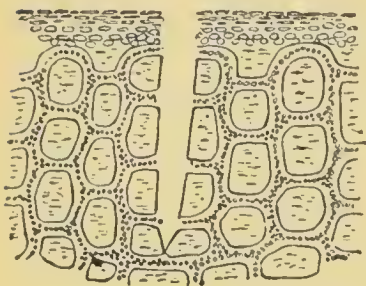


FIG. 1.—Incised wound.

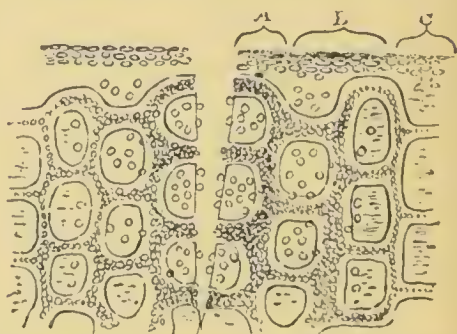


FIG. 2.—Exudation of leucocytes commencing.

(From *Walsham's Practice of Surgery*, 2nd Edition.).

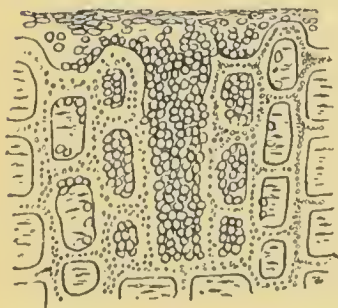


FIG. 3.—Exudate filling up wound.

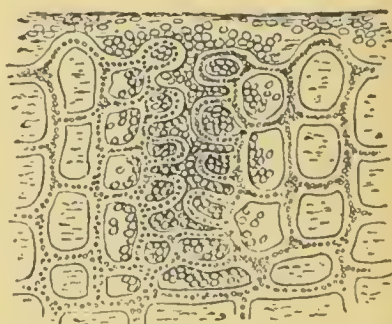


FIG. 4.—New loops of blood vessels being formed.

(From *Walsham's Practice of Surgery*, 2nd Edition.)

partly in response to the irritation set up by the injury.



This is accompanied by an increased rate of the blood stream : indeed this is no more than the first stage of inflammation under whatever conditions it may occur, a condition to which the name hyperæmia has been given. Next the blood stream becomes slowed, it may be till stagnation of the current takes place (stasis) and with this there is more or less oozing of the blood serum into the injured tissues together with the passage of the white blood corpuscles (leucocytes) through the vessel walls. These leucocytes, as we shall see later, may be looked upon as the scavengers of the body. It is their function to destroy and get rid of germs ; and it depends on the number and the virulence of the germs whether or not the leucocytes are successful in their work. This serous oozing and leucocyte emigration together forms what we are accustomed to call an exudation or exudate ; and this exudate begins to clot with the formation of fibrin, the result being a sticky

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material which, so to speak, sticks together the apposed surfaces of the wound. The cells of the exudate are joined by a multiplication of the cells of the injured tissue and the result is a formation of new connective tissue which gradually becomes supplied with new blood vessels. As time goes on contraction takes place in the cicatrix or scar resulting from the wound.

In the case of a non-septic wound where, owing to the loss of substance, healing by first intention is impossible, the exudate coagulates on the surface of the wound, fibrin is formed as before and the wound becomes covered with a whitish film. This gradually increases in extent and thickness, and repair is seen to take place in the form of small granular red points covering over the raw surface. These points are known as "granulations" and consist of newly formed capillaries enclosed in masses of cells. These granulations continue to spread and grow in size so as gradually to fill up the wound, and

coincidentally with this the connective tissue, which is gradually being formed from below, is contracting and diminishing the size of the wound. A scar results from the healing process. When a wound becomes septic owing to the invasion of pus-producing micro-organisms there are produced poisonous substances named toxins which are injurious to the damaged tissues. The affected tissues thereby become softened and dissolved, and with the free exudate escaping from the involved blood-vessels, become thrown off from the wound as pus—in short, suppuration occurs. Some of these toxins may and often do enter the blood and cause more or less constitutional disturbance, as is evidenced by fever, rigors and general malaise. As the virulence of the infection declines the leucocytes reassert themselves, forming a sort of protective boundary, and granulations make their appearance and repair takes place in the way we have described.

### CHAPTER III.

The requirements for the promotion of primary healing  
—The arrest of hæmorrhage.

FOR the promotion of the primary healing of a wound there are certain requirements necessary. These are : (1) the arrest of bleeding ; (2) the sterilization of the wound ; (3) the apposition of the edges of the wound by sutures ; (4) the avoidance of tension in the wound, by drainage, when necessary ; (5) the protection of the wound by dressings ; (6) the provision of rest, it may be by the use of a splint ; and (7) general treatment. These we shall consider *seriatim*.

Hæmorrhage is usually present in a wound. It may be arterial, venous, or capillary.

Arterial hæmorrhage is recognized by the discharge of blood in jets, corresponding to the beat of the heart. It is bright red in colour. Venous hæmorrhage is continuous, welling up in the wound. The blood is dark red or purplish. Capillary hæmorrhage is the most common, and usually takes the form of a general oozing. Exposure to the air is often sufficient to arrest capillary hæmorrhage ; or it may be checked by pressure for a short time by means of a finger or sterilized swab, or, in the case of the upper or lower limb, by elevation of the affected part. It is customary to divide the means adopted for the arrest of hæmorrhage into temporary and permanent. Temporary measures include, in addition to pressure, artery forceps and the tourniquet.

Various types of artery forceps are in use, the most commonly used being those which bear the name of Spencer-Wells. Of tourniquets Esmarch's is generally used. This consists of a

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stout piece of rubber tubing with a hook at one end and a chain at the other. The tubing is wound tightly round the limb above the wound, underneath it being placed a strip of lint to prevent undue compression and bruising of the tissues. It is gradually relaxed, when the bleeding vessels are tied or twisted. Permanent measures include the ligature, torsion, the application of heat, cold, styptics, the cautery and pressure.

The ligature is the method most usually adopted. The material used must be strong enough to secure the bleeding vessel and to maintain its hold when soaked by the fluids of the body ; it must also be capable of being absorbed or of becoming encapsuled in the tissues without causing irritation. It is thus essential that the ligature be carefully sterilized. The ligature must be tied in a reef-knot and not a "granny" knot. Silk and catgut are the materials generally employed. Torsion consists in seizing

the vessel with a pair of catch forceps and forcibly twisting it several times. It is usually applicable only to small vessels. This is what happens in a lacerated wound and accounts for the absence of bleeding which is so often noticed in such an injury.

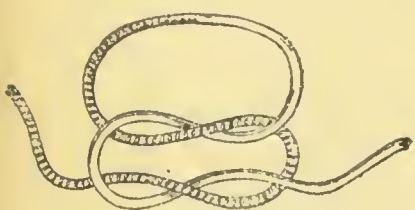


FIG. 5.—Reef knot.

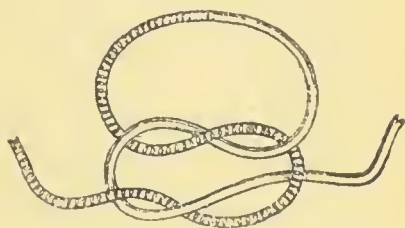


FIG. 6.—Granny knot.

Heat is a powerful agent in checking hæmorrhage, but to be effective the water must be really hot, not below  $130^{\circ}$  F.; and the water must be rendered antiseptic by the addition of carbolic or other antiseptic, unless it has been previously boiled. The muscular fibres in the walls of the divided blood-vessels are thus made to contract and to seal up the vessel, and the coagulation of the blood is also promoted.



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Cold is of value in general oozing from a vascular surface, such as the face of a stump after amputation, rather than in sharp hæmorrhage. It must be remembered that ice may convey sepsis and that the water must be sterile.

Styptics are chemical agents which when applied to a wound tend to check hæmorrhage, primarily by promoting the coagulation of the blood. They are not so much used now as formerly. Examples are strong perchloride of iron, tannic and gallic acids and nitrate of silver. Adrenalin is the strongest styptic we possess. It is a physiological substance, which is derived from the suprarenal capsules which lie just above the kidneys on either side. It acts by constricting the blood-vessels. It is commonly used combined with cocaine solution for spraying over a bleeding surface.

The cautery is occasionally used to control hæmorrhage. It is used at a dull red or black heat. If used red hot it simply cuts through



the vessels like a knife. It is specially applicable in operations for piles (hæmorrhoids).

Pressure may be applied in various ways as a pad of lint over the bleeding area or as a plug stuffed into a bleeding cavity such as the interior of a bone. In a wound of the hand, for example, where the large vessels of the palm are involved,



FIG. 7.—Cavity packed with gauze or cotton wool, enclosed in a piece of protective to arrest hæmorrhage. *p.* Protective. *g.* Gauze or cotton-wool.

a firm pad may be placed in the bend of the elbow and the forearm bent on the upper arm and bandaged to it in this position. This can only usually be done for a short time, as it is apt to be painful and there is a risk of obstructing the circulation and producing gangrene.

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Hæmorrhage is regarded as primary when it occurs at the time of the accident or during an operation. When it occurs within twenty-four hours of the injury or operation it is known as reactionary, because of its tendency to come on during the reaction period. Any hæmorrhage occurring after twenty-four hours is spoken of as secondary. This is rare now.

## CHAPTER IV.

The requirements for the promotion of primary healing  
(*continued*)—The sterilization of the wound—Antisepsis—Asepsis—The various antiseptics—The apposition of the wound edges—Sutures—Drainage.

HAVING checked the hæmorrhage we now proceed to the sterilization of the wound. Since the late Lord Lister's valuable discovery of antisepsis the treatment of wounds has been placed on an entirely new basis. He recognized that the chief danger in treating wounds lay in their liability to infection by micro-organisms (bacteria) which are present everywhere in greater or lesser numbers, in the air, on clothes, instruments, the patient's skin and so on. The

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object of the antiseptic treatment of wounds is the prevention of the development of bacteria in wounds by the use of chemical substances which either actually destroy bacteria or inhibit their growth. Many means of achieving this object have been devised and many substances have been used, but latterly the methods have been much simplified ; and nowadays we have come to rely on what we speak of as asepsis rather than antisepsis. That is to say, instead of employing powerful and poisonous substances to the tissues by which the wound is liable to be irritated we make use of dry or moist heat as a sterilizing agent, so that everything which is brought into contact with a wound is aseptic or sterile.

This applies more especially to surgical wounds. In the case of casual or accidental wounds we still have to rely on antiseptics and we have to see to it that the antiseptic selected is sufficiently powerful to achieve the object we have in view without being so strong

as to damage the tissues. Sometimes we may let the wound soak for some time in the anti-septic, and then wash it well out by means of the irrigator ; or, in the case of a severe lacerated wound of one of the limbs, good results may be got by immersing the limb in a warm antiseptic solution, such as boracic lotion, the water being kept at a fixed temperature. This may be continued sometimes for several days. Again, the surgeon's and nurse's hands and the patient's skin in the neighbourhood of the wound cannot be rendered aseptic apart from the use of anti-septics, and so we can never dispense with their use in the management of a wound. In the case of operations the most elaborate precautions are now taken to prevent contamination of the wound. Thus, instruments, ligatures, and sutures are boiled before use ; swabs, dressings, and towels are sterilized and kept in sealed tins till wanted : water is boiled. The surgeon and his assistants cover their heads, except the eyes,

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with a sterile gauze veil and they wear sterilized gloves.

The antiseptics most commonly used are carbolic acid, the first antiseptic introduced by Lord Lister, corrosive sublimate (perchloride of mercury), biniodide of mercury, lysol, lysoform, chinosol, izal, creolin, cyllin, iodoform, iodine, peroxide of hydrogen, boric acid, salicylic acid and formalin. Carbolic acid is sometimes applied to infected wounds in the pure state, but more often it is used in the strength of 1-20 or 1-40. The 1-20 solution is a powerful antiseptic and is suitable for sterilizing instruments. The weaker solution is more suitable for application to a wound, as it is less liable to irritate the tissues.

Corrosive sublimate is a valuable antiseptic but it is very poisonous. It is used in solutions of from 1-1000 to 1-5000. It is not suitable for sterilizing instruments as it damages the plating. The biniodide is less harmful for in-

struments. It is used in the same strength as the perchloride. These solutions being colourless it is usual to add a colouring agent so as to distinguish them. Lysol, lysoform, chinosol and cyllin are coal-tar derivatives. The first named has the advantage of being somewhat viscid. It is commonly used as a 2 per cent solution, that is to say about three teaspoonfuls to a pint of water. Chinosol is a yellow powder which is harmless and free from poisonous qualities. It is, too, a powerful antiseptic. Half a teaspoonful to two pints of water makes a solution similar in its action to a 1-40 solution of carbolic. Izal is an admirable antiseptic for routine work. It has the same advantages as chinosol; in addition it is cheap. A teaspoonful in a quart of boiled water suffices for recent wounds. In suppurating wounds double this strength is advisable. It is hardly necessary to say that prior to the sterilisation of a wound any extraneous substances will as far as possible be removed. The wound



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may be contaminated with road dirt, grease, hair, grit, glass, etc. All these will require a liberal application of warm sterile water or antiseptic lotion, particular attention being paid to the corners and crevices of the wound and to the surrounding skin. The use of a sterile nailbrush will often be needed for the skin and perhaps, gently applied, for the surface of the wound. It may be necessary to enlarge the wound to make certain of its thorough cleansing. Tags of skin and damaged pieces of fatty and connective tissue may require to be snipped off.

The apposition of the edges of the wound must next be considered. It is not always the best treatment to entirely close a wound, even when such a course is possible ; for the edges may be rough and the tissues around bruised so that they are less able to offer resistance to invasion by pus-producing (pyogenic) germs. However careful we may be in the use of antiseptics and aseptic precautions we are often



unable to be certain that the wound is germ free. Again, in the case of a careless, dirty patient or one who is constitutionally below par, for example an alcoholic or a diabetic, there is more chance of sepsis occurring and the repair of the tissues is apt to be slower. There may be, too, a certain amount of tissue which, owing to the damage it has undergone, fails to recover, and, dying, is eventually thrown off as a slough. Briefly then, recent incised wounds, where there is a free blood supply, are usually closed ; lacerated wounds are left open with a light gauze packing. It is with regard to the intermediate varieties that there will be some difference of opinion, and in such wounds the edges may be sutured at wide intervals, allowing room for the discharges to escape. Sutures offer the best means of closing a wound although some surgeons make use of sterile metallic clips, or strips of strapping cut narrow in the middle with a layer of gauze underneath or strips of

gauze applied transversely, the ends being fixed to the skin with collodion.

It is important that the edges be accurately brought together, without any infolding of the skin, and that undermining of the edges be, as far as possible, avoided. The materials used for sutures are numerous. Those most commonly used are catgut, silk, silkworm gut, horse-hair, and silver wire. For superficial wounds the three last named are most suitable, the scar left after their removal, especially in the case of horse-hair, being very slight. The methods of applying sutures are various; for example, they may be interrupted, continuous, where the suture is carried from point to point; or the suture may be of the "mattress" or "blanket" type. All sutures must be rendered sterile by boiling before use. The same applies to needles. These may be more or less curved or straight. Sometimes needles mounted on a handle are used, and many forms of needle-holders have been

devised to assist the surgeon in passing sutures through the tissues. The avoidance of tension in a wound is necessary to promote healing. In every wound there is a certain amount of fluid (exudate) poured out, depending on the size and character of the wound. This we have seen to be an excellent medium for the growth of germs. Hence one reason why, when at all abundant, it should be got rid of. But in addition to this, the pressure of the fluid puts a strain on the sutures and causes pain. Drainage, then, becomes necessary to remove this fluid when in excess. This may be promoted by allowing the exudate to escape between the sutures when not placed too closely together. But further means may be required, varying from a strand of horse-hair or a strip of gauze, in the case of smaller wounds, to rubber or glass drainage tubes of varying size. We have spoken of the ordinary serous exudate which takes place from a wound, but there may be

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more or less hæmorrhage which requires to be drained away.

A very wise aphorism is "when in doubt, drain". In most incised wounds which can be brought together drainage is unnecessary, unless the wound be a very large one, when we may require to put in a tube for twenty-four hours to avoid tension. In septic wounds we must employ drainage to remove the products of suppuration. In employing drainage the tube is placed at the most dependent part of the wound. It should not be kept in any longer than is absolutely necessary, otherwise it will promote suppuration by acting as a foreign body. On the other hand, if removed too soon the discharge may accumulate in the deeper part of the wound, and give rise to trouble. India-rubber tubing of different sizes with holes cut in it laterally is usually used. Before being introduced the tube is sterilized and is generally fixed in the wound with a safety-pin or stitch

to prevent it passing completely below the skin. The end of the tube outside the wound is surrounded with gauze, into which the discharge passes. Drainage-tubes are now used much less frequently than formerly, owing to the improved methods of managing wounds.

## CHAPTER V.

The requirements for the promotion of primary healing  
(*concluded*)—The dressing of a wound—Rest—  
General treatment—Simple traumatic fever—Heal-  
ing by granulation—Skin grafting—Bier's treatment.

THE wound is now ready to be "dressed" after the surrounding skin has been dried. The objects we aim at are : (*a*) to protect the wound ; (*b*) to absorb discharges therefrom ; and (*c*) to bring to bear equable pressure on the wound, which checks oozing and supports the injured part. Next to the wound is placed some form of gauze. Sometimes an antiseptic dusting powder is applied before the gauze, but this is not usual. The double cyanide gauze of mercury and zinc recommended by the late Lord

Lister is a favourite dressing. The requirements of an antiseptic gauze are that it should be un-irritating, that the antiseptic contained in it should not be easily dissipated, and that the material should be such that discharges from the wound are readily absorbed by it. In the double cyanide gauze all these essentials are fulfilled. Where, following operation, the surgeon is satisfied that the wound is aseptic he is often content to use simple sterilized gauze. Other antiseptic gauzes are those impregnated with carbolic, iodoform, izal, etc., etc. The gauze should more than cover the wound and over it is placed a sufficiency of sterilized or antiseptic absorbent wool or "gamgee tissue". This is light and moreover allows considerable pressure to be made with the bandage. Now the bandage is applied over all. The butter-cloth bandage is the best for ordinary purposes, but other materials may be used, such as gauze, linen, or domette. Sometimes a surgical wound



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is dressed by means simply of a piece of gauze, the edges of which are sealed down to the skin by means of collodion.

Having dressed the wound means must be taken to ensure that the affected part is kept at rest. If no drainage has been required the wound is usually left undisturbed for seven or eight days, when the dressings are removed, the stitches taken out and, if all has gone well, "primary healing" has taken place. It is seldom necessary to retain a drainage tube for more than twenty-four or forty-eight hours. The guides on which we are accustomed to rely in deciding when a wound requires dressing are the temperature, pulse, discharge and the sensations experienced by the patient. A rise of temperature, an increase in the frequency of the pulse, and pain in the wound usually indicate that dressing is required. In carrying out the principle of rest we make use of position or, it may be, a splint, pillow, or a sling. Here reference may be made to the necessity of



avoiding any interference with the circulation of the blood in the injured part and its neighbourhood, thus producing congestion of the veins and,

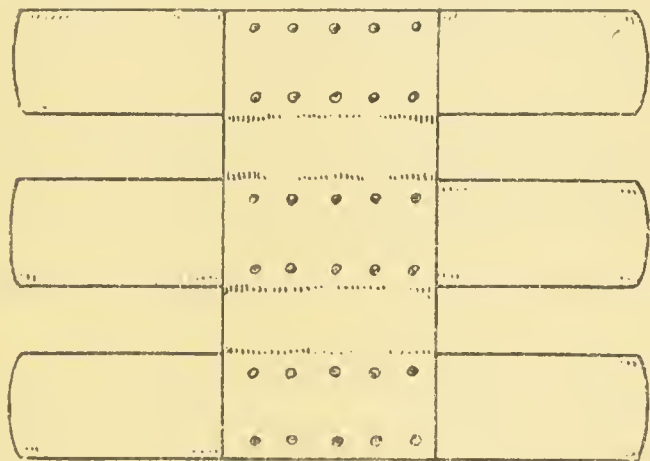


FIG. 8.—An illustration of a splint made of lead, such as might be used in the case of a compound fracture. After the limb is placed on the splint the sides are bent up to act as lateral splints.

it may be, œdema (local dropsy of the tissues). More rarely, interference with the arterial blood supply has even produced gangrene. Where the

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wound involves a hand or foot it is advisable to keep the part raised to obviate venous congestion. It is hardly necessary to insist on the same precautions regarding asepsis being taken each time when the wound is "dressed". Failure in this respect has not infrequently in the past caused infection of a previously sterile wound. After the stitches have been removed it is generally advisable to apply an antiseptic dressing—probably a smaller one will suffice—for another week.

The general treatment which is called for in the management of a wound must of necessity vary according to the condition of the patient and the kind and severity of the injury. Briefly it includes all that conduces to the general health of the patient. Complications such as shock, hæmorrhage, perhaps a broken bone, must of necessity call for treatment apart from the actual management of the wound itself. The

patient may be the subject of heart disease, alcoholism, diabetes or other constitutional affection; again, we have to consider the influence of the extremes of life. Sepsis may be present and cause more or less severe constitutional symptoms. But even supposing that we are dealing with a moderately severe wound, which has been rendered sterile, in an otherwise healthy subject, there is generally some degree of reaction, showing itself, it may be, in a certain degree of fever, a coated tongue, loss of appetite and general malaise. Such a state of affairs we speak of as simple traumatic fever (Gk. *trauma*, a wound) (see p. 59). Pain may be severe and necessitate the use of an opiate. Sleeplessness, too, may call for a sedative draught. It is advisable when dealing with a wound, unless comparatively trivial, to keep the patient for a couple of days on light or even slop food and to administer a purge; a dose of calomel at night followed by a

saline draught in the morning answers well. Especially is this necessary when a previously healthy, robust and active patient is suddenly confined to bed. It stands to reason, too, that muscular inactivity does not call for so full a diet as is demanded by a man engaged in his ordinary pursuits.

Alcohol is generally contra-indicated unless special circumstances call for its use. A considerable loss of blood will demand special treatment. The importance during convalescence of good food and plenty of fresh air must not be overlooked.

We have now given a brief outline of the management of a wound where "primary healing" is to be looked for. Much of what has been said will still apply in the case of a wound where healing by first intention is out of the question. The bleeding must be arrested as before and the wound sterilized as far as possible, but it will generally be impossible to bring the

edges together. The free discharge, which may be purulent, will demand frequent dressing of the wound, it may be every hour, when, for example, boracic fomentations are being employed. Here, too, free drainage is necessary. A useful way of treating a septic wound of one of the limbs is to immerse the part in a bath of warm antiseptic solution such as boric lotion. This may be continued for several days if necessary. As time goes on and the wound begins to granulate up it may be necessary to aid the healing process by stimulating lotions, such as sulphate of zinc, or to check exuberant granulations (popularly known as "proud flesh"). Sometimes a large granulating surface may require skin-grafting to allow of healing. Several small pieces of skin may be employed in the form of little islands applied to the surface of the wound, or sometimes large pieces of the upper part of the skin (cuticle) may be used. To enable these to "take," the granulating sur-

face should be "clean," discharging no pus but merely serum. Obviously great gentleness must be used in transplanting the grafts. After applying the grafts the surface of the wound is covered with protective and an antiseptic dressing, and left for several days undisturbed.

Of recent years horse serum has been injected subcutaneously in certain cases to promote the healing process; and this has met with a considerable degree of success. We know that the serum of healthy blood contains substances which are inimical to the growth and development of pus-producing micro-organisms.

Finally, in this connexion we must refer to a treatment instituted by Professor Bier of Berlin. It consists in increasing the inflammatory action by interfering with the return of blood from the injured or diseased area. The principle involved is capable of application to a variety of affections characterized by acute or chronic inflammation. Here we are only concerned with the value of

this method of treatment as applied to wounds. The treatment implies that the inflammatory action taking place in and around a wound is a beneficial one, and the rationale of the method can only be understood when we realize, as we have now come to do, that inflammation and wound repair are really one and the same process, merely differing in degree according to the severity of the cause which has set up the reaction. Bier's treatment has thus been found to be of value in septic wounds, and in contused and lacerated wounds which have been contaminated at the time of injury and where sepsis is feared. In addition, however, to its value in checking or preventing infective processes in wounds, threatened suppuration may be averted and pain is often relieved by its use. Of the three methods of application, namely by elastic compression, by cupping glasses and by the application of hot air, it is only the first named that we need describe in the present connexion. Suffice it to say



that elastic compression causes an obstruction to the return of the venous blood from the part affected, that is to say, a passive congestion or hyperæmia. Suction with cupping glasses causes an increase in the rate of the blood flow in the arteries at the seat of application, coupled with an increase in their bore or "calibre"; that is to say, an active congestion or hyperæmia; this is soon followed by a passive hyperæmia. Hot air causes solely an active hyperæmia, the veins being unaffected.

For the carrying out of elastic compression all that is required is an elastic bandage for the limbs or a garter for those parts where a bandage is inapplicable. The bandage should be thin and soft and of sufficient length to go one and a half times round the limb. Before the bandage is applied the wound is inspected and cleansed, preferably with warm saline solution (a teaspoonful of common salt to a pint of boiled water) rather than with strong antiseptic



lotions and a sterile gauze dressing is applied loosely over it. The reason for applying the sterile gauze dressing is not only to protect the wound, but, in the event of the bandage being applied close to the wound, to save the wound from undue pressure when the swelling of the limb, following the compression, occurs. However, it is better to put on the bandage at some considerable distance above (on the heart side of) the wound. For example, in the case of a lacerated wound of the foot or ankle the bandage is best applied around the lower part of the thigh. It is recommended that a piece of boric lint intervene between the skin and the bandage, and that the limb be placed in the position it is subsequently to occupy, before the bandage be applied. The amount of constriction to be procured is important to the success of the treatment, and it is this which is the most difficult part of the procedure as it can only be learnt by experience. But there are one or two

cardinal points to be observed ; the pulse beyond the constricted area must not be obliterated. The limb must never be allowed to become cold, unduly dusky or pale, and pain should be removed or relieved ; to settle this question sufficient time should be allowed to elapse before the doctor or nurse leave the patient. If these points be not observed serious damage may be caused, even gangrene of the limb. When the bandage has been correctly applied the surface veins gradually become engorged, the limb swells and the inflamed area becomes more extensive. These signs need cause no alarm so long as the points already mentioned have been attended to. As regards the length of time the bandage is applied no rule can be laid down. An average length of time is nine hours "on" and three hours "off" in chronic cases ; in acute cases and in children it will often be impossible to apply the bandage for so long a period, but each case must be "a law unto itself". After

the bandage is removed the limb should be elevated and the constricted area sponged with methylated spirit.

Elastic compression should not be carried out save under direct medical supervision.

## CHAPTER VI.

### THE COMPLICATIONS OF WOUNDS.

#### Hæmorrhage—Shock.

WE now come to speak of the complications of wounds and their management. The first we shall deal with is hæmorrhage. This can only be regarded as a complication when it is profuse or returns after the wound has been treated. Hæmorrhage, occurring as a complication, may be due to injury to one of the large vessels or to disease of the blood-vessels. Again, some constitutional disease, such as scurvy, may account for it, or the condition known as hæmophilia, where the coagulating property of the blood is defective. We have considered the means for arresting

hæmorrhage and need not therefore return to this subject. We are more especially concerned now with the symptoms and signs produced by a profuse loss of blood and the management of such a catastrophe. The severity of the symptoms depends rather on the rapidity of the loss of blood than on the amount actually lost. The patient is usually pale, the skin is cold and clammy and the pulse rapid and feeble or even absent. There may be yawning, great restlessness, faintness, flashes before the eyes. Actual fainting may ensue, arising from a deficient supply of blood to the brain, and death may soon follow if the loss of blood has been very great or if it cannot be checked. It must not be forgotten, too, that severe hæmorrhage may take place into the tissues around a wound, which then become boggy and swollen, and death may occur without any considerable quantity of blood escaping from the wound. The liability to the occurrence of secondary hæmorrhage in

a large sloughing wound, at the time of the separation of the sloughs, must not be lost sight of.

In the management of profuse hæmorrhage from a wound the first indication is, of course, to stop the bleeding, first temporarily and then permanently, in one of the ways we have considered, and also to deal with the effects produced by the bleeding. It is useful to know the appropriate spots where pressure is best applied (the "pressure point") to check bleeding from a large artery. Such a "pressure point" is always on the heart side of the wound and in a line with the course of the artery supplying the wounded area. Pressure may also be made on the wound itself either by the fingers or thumb or by a pad and bandage or sometimes also by flexing the knee or elbow and keeping the limb in this position in wounds say of the leg or foot, and of the forearm or hand respectively.

It may, in an emergency, be necessary to improvise a pad and bandage to place over the pressure point or the wound. A handkerchief folded up may suffice as a pad, or a smooth stone may be enclosed in the centre of the pad to aid the pressure. Again, a tourniquet may be improvised by half tying a bandage round the limb after fixing a firm pad precisely over the pressure point or over the wound; then laying a stout piece of stick on the half knot and completing the knot as a reef knot. As the stick is twisted round, the bandage is tightened and pressure is made on the pad and the hæmorrhage is stopped.

The immediate management of a wound complicated by profuse arterial hæmorrhage may, then, be summarized as follows: (*a*) lay the patient flat; (*b*) raise the bleeding part; (*c*) expose the wound; (*d*) apply pressure either on the bleeding spot, if the wound is small, or, if the wound is large, on the heart side; (*e*)

cleanse the wound, removing foreign bodies such as dirt, glass, etc. ; (*f*) protect the wound with the most suitable dressing available at the moment, such as a clean piece of linen, until a proper dressing is available ; (*g*) apply a bandage firmly over the dressing (*N.B.* if the wound is complicated by a fracture care must be taken not to aggravate the injury) ; and (*h*) support the wounded part.

It must be remembered that faintness or actual fainting as a result of severe hæmorrhage does not necessarily demand the use of stimulants. This is Nature's way of stopping bleeding. When fainting occurs the blood flows more slowly and with less force, and thereby clotting is favoured. The administration of stimulants is best left to the doctor. The patient's head should be kept low and the limbs, as a rule, raised and hot bottles, protected, applied to the feet. The foot of the bed may be raised on blocks.



In severe cases of hæmorrhage infusion is often resorted to, that is to say the introduction of saline fluid (a teaspoonful of common salt dissolved in a pint of boiled water at a temperature of 105° F.) into the rectum, into a vein (this is generally known as transfusion), or directly into the tissues in such a situation as the groin, the loins, the axillæ, or under the breasts. This does good by giving the heart more fluid to act upon. The fluid is most easily injected into the rectum but absorption is not so rapid as when the injection is made into a vein. The patient lies on the left side with the knees well drawn up and the buttocks well raised. A large rubber catheter which is connected with a piece of rubber tubing, to which is attached a glass funnel, is passed well into the bowel (after being lubricated), one pint of the fluid is allowed to run in slowly (allow ten minutes), the funnel not being held high, or else the solution will be rejected. Brandy (an ounce to the pint) or adrenalin (two

to ten drops to the pint) may be added to the solution, and the injection may, if necessary, be repeated in a couple of hours.

Injection into a vein is a more complex method. The vein at the bend of the elbow is the one usually selected. The vein is made to "stand out" by tying a ligature or bandage round the upper arm, which is of course removed before the fluid is injected. After rendering the skin aseptic an incision is made obliquely over the vein, a double ligature is passed under the exposed vein, and the distal ligature (after cutting the loop of silk) is tied. When the transfusion apparatus is ready the vein is opened and the point of the curved glass cannula is introduced into the vein (care is taken to prevent any air being admitted); the proximal ligature is then tied gently round the part of the vein which contains the cannula, and the fluid is allowed to run in slowly in the same way as we have described. About one

pint is usually injected, the cannula is then withdrawn, the proximal ligature is tied, and the wound closed with a stitch, and a dressing and bandage are applied.

Injection into the tissues is performed by means of a hollow needle connected with a can by means of rubber tubing. Absorption is slow and only a few ounces can be injected in one situation. After the urgent symptoms have been relieved the diet must be carefully regulated, fluid food only, in small quantity and at frequent intervals, being allowed at first, to be gradually followed by fish, poultry, and finally butcher-meat. Tonics and change of air will generally be required subsequently.

The next complication to be considered is what is known as Shock. By this is meant a depression of the nervous system brought about by powerful impressions from the sensory nerves. It is often produced by severe injuries, especially those which affect vital parts of the body

such as the abdomen. It is seen, too, in cases of profuse hæmorrhage and sometimes after severe operations. The temperament, too, of a patient, may help to determine the onset of shock after a severe injury. The sensitive "highly strung" patient is more liable to suffer from shock than the patient exhibiting the opposite temperament. The symptoms vary in degree according to the severity of the injury from a slight feeling of giddiness or faintness to severe and rapid prostration, loss of consciousness and death. In a severe case such as that which might follow on a compound fracture of the thigh the patient lies quiet. He is pale and is covered with a cold, clammy sweat. His pulse is feeble or absent and his breathing shallow. He is semi-conscious or totally unconscious.

There may be loss of control of the bladder and bowels. If he complain of no pain the outlook is more grave. These symptoms may soon

end in death, but more often, after a shorter or longer period, the stage of reaction follows. The temperature, which was subnormal, begins to rise, the pulse becomes stronger, sickness may supervene, and muscular power returns. The patient may now become irritable and even delirious, or extreme restlessness may be shown. These are bad signs.

Our first indication in managing a case of shock is to apply warmth to the body. Hot bottles, carefully protected, or hot bricks, should be applied to the feet, and a quickly acting stimulant given by the mouth, if medical advice is not at once forthcoming. Ether, sal volatile, and brandy are most generally used for this purpose. Many doctors, however, are now coming to believe that stimulants are not of much use in the treatment of shock, and that a hypodermic injection of morphia does more good; also that the object to aim at is to increase the blood pressure and arterial tone by injecting adrenalin,

or what has even a more lasting action than adrenalin in this respect, namely, pituitary extract. Hot tea, coffee, or Liebig may be administered by the mouth, or a nutrient enema may be given.

When reaction comes on, symptoms such as fever, vomiting, and pain will call for treatment. For the last named, opium or morphia is usually required.

## CHAPTER VII.

Traumatic fever—Sapræmia or septic intoxication—Septicæmia or septic infection—Pyæmia—Hectic fever—Erysipelas—Tetanus—Rabies—Delirium—Complicated fracture—Compound dislocation—Penetrating wound of a joint—Gangrene.

WE now come to a group of diseases known as the surgical fevers, because they are for the most part concerned with the production of wounds.

(1) The first of these is known as traumatic fever (belonging to or caused by a wound). This is commonly seen as the result of an injury, such as a severe blow or simple fracture, or an operation where the wound is perfectly healthy. It rarely lasts more than a few days, and requires no treatment. The temperature may reach  $101^{\circ}$  F.,



but soon falls. The usual symptoms of mild fever are present—the coated tongue, loss of appetite, and rapid pulse. It must be borne in mind that this condition is in no way dependent upon germs, and is thus distinguished from the remaining members of this group, which owe their origin to the introduction into the blood either of germs or of poisons produced by them.

(2) Sapræmia, or septic intoxication. This disease occurs as a result of putrefactive processes set up by certain germs (the germs of putrefaction), which produce poisons called ptomaines. The poisons, when absorbed into the blood, cause symptoms which depend for their severity on the quantity absorbed. We may have therefore a mild sapræmia (generally spoken of simply as “sepsis”) following upon a small dose of the poison, and a severe form of the disease when the amount of poison in the blood is large. In the latter case, which is often combined with the next type of fever to



be considered, namely septicæmia, death may result.

When the putrefaction is removed, the symptoms of sapræmia depart, provided the quantity of poison absorbed has not been too large. The poison does not multiply in the blood, nor is the blood infective, as it is in septicæmia.

Sapræmia is often present in the case of a septic wound, where death of the tissues has occurred, with consequent putrefaction. Generally the first indication of there being anything wrong is an acceleration of the pulse, and if this be continuous it may act as a danger signal even before the temperature begins to rise. So the nurse must be on the look-out for this sign and must lose no time in reporting it. This is followed by a rigor and a rise of temperature which is usually up to  $101^{\circ}$  or higher by the third day after the production of the sepsis. It generally falls on or before the ninth day, when the wound is healing. The symptoms are those

of mild fever—namely, thirst, loss of appetite, constipation, headache and perhaps slight delirium. The skin is hot and the tongue coated. In the severe form of the disease there is usually shivering, with a rapid rise of temperature. The pulse is quick and feeble; the tongue brown, glazed, and parched. Vomiting and diarrhoea are often present, and there is great prostration. The disease may advance, and the patient become unconscious. The temperature now often falls, and death may result even as early as the third or fourth day.

The management of sapræmia is both preventive and curative. The former consists in the strict observance of the principles of asepsis and antisepsis in dealing with wounds. Thereby putrefaction is avoided. When putrefaction has, however, occurred, it must be removed with the least possible delay. In dealing with a septic wound we endeavour to establish free drainage, using mild non-irritating antiseptic lotions. In

severe cases the question of amputation may have to be considered in order to save life. The strength must be maintained to the full by plenty of nourishment given at short intervals, stimulants, and drugs such as digitalis and strychnine to strengthen the heart.

(3) Septicæmia, or septic infection. Whereas sapræmia has been seen to be the result of the absorption of poisons resulting from putrefaction, septicæmia is due to a living poison, a germ, which, having gained admission to the blood, multiplies there with alarming rapidity. If a small quantity of the blood of a person suffering from this disease were injected into one of the lower animals, for example the guinea-pig, the animal would become affected ; the blood is, in short, infective. The poison may gain admission into the blood through a small prick on the finger, such as may occur during the making of a post-mortem examination. Such a mode of origin is unfortunately only too common, and

constitutes a serious risk in the examination of subjects recently dead of the disease.

Supposing the poison to have gained admission in such a manner as we have indicated, symptoms may arise even in twelve hours' time. The lymphatic vessels of the arm soon become affected, and stand out as red lines coursing up the arm, which is now swollen and tender. Other early symptoms are rigors and great prostration. The temperature may quickly rise to  $104^{\circ}$  or  $105^{\circ}$  F. The symptoms are very similar to those of severe sapræmia, their severity, however, being out of all proportion to the size of the wound.

The management of septicæmia is by no means so satisfactory as is that of sapræmia, for we cannot remove the cause; the poison is not merely circulating, but is also multiplying in the blood. We cleanse a septic wound as thoroughly as we can, as we have already seen. It is even more necessary in this disease to sup-

port the strength by every means in our power. During the last few years the application of the serum method of treating disease has been extended to this affection. The results have been distinctly satisfactory when the serum has been used sufficiently early. If its use is delayed, the results are more unfavourable. For an account of the serum treatment of disease see the author's Handbook for Nurses, pp. 309 and 310.

(4) Pyæmia. In this disease, which is closely allied to septicæmia, germs gain admission into the blood by the veins which lead away from the seat of suppuration. These germs, which may be contained in fragments of blood-clot (emboli) which have become dislodged, or in the leucocytes, are carried by the veins to the right side of the heart, and thence to the lungs, where, becoming arrested, an abscess is formed ; or again, passing through the capillaries of the lung, they may reach the various organs and

tissues of the body. Thus arise the numerous abscesses which characterize this disease.

Pyæmia never occurs without suppuration.

Where there is a wound, pyæmia is usually preceded by a change in its appearance. Its edges become puffy and swollen. Feverish symptoms develop, or, if already present, become exaggerated. But the most characteristic sign of the disease is a severe rigor, with a rapid rise of temperature. The rigor may last only a few minutes, or possibly an hour or more, and with its departure the temperature falls and sweating ensues. Pyæmia generally commences about the tenth day after an accident or wound, and there may be one or several rigors in the first twenty-four hours.

The chart (fig. 9) represents a case with a rigor occurring daily in the latter part of the day. The temperature does not usually fall to normal, at any rate at first, as we shall find it does in hectic fever. The additional symptoms

correspond very closely with those we have already mentioned. It is usually some days, often a week, before the abscesses appear. These, as we have seen, may form anywhere; but the lungs are generally first affected, as being the first resting-place of the germs.

The liver, spleen, kidneys, and the joints are often the seat of abscesses in this disease. As the patient becomes worse the rigors become more frequent, the pulse weaker and more rapid, and pleurisy or pneumonia may now set in. Death results usually from gradual heart failure and exhaustion, but it may occasionally occur suddenly. Sometimes pyæmia runs a more chronic course, when recovery is more hopeful, but often at the expense of one or more disorganized and stiff joints, as a result of abscess formation and consequent destruction.

The treatment of acute pyæmia offers but little hope when the disease is established. The management differs little from that of severe



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sapræmia and septicæmia. Quinine given in large doses in anticipation of a rigor may tend to check it, but it is of no great value. After

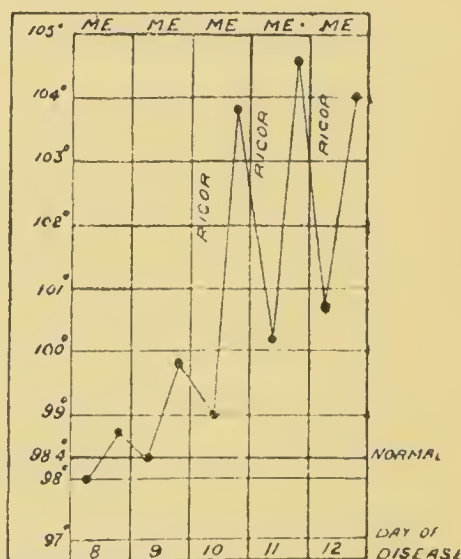


FIG. 9.—Temperature chart in a case of pyæmia, with daily rigor followed by sweating.

the rigor, when the patient is left prostrate, a quickly acting stimulant will usually be required. Locally, wounds must be carefully drained and cleansed; but this is to be regarded rather as



a preventive measure. Amputation may be required.

Abscesses are opened as soon as they are diagnosed and treated on antiseptic lines.

In the event of recovery, tonics, change of air, and a generous dietary will be ordered.

It cannot be too strongly impressed upon the nurse that this and the two preceding diseases are to a large extent preventable by strict attention to cleanliness, both generally and locally, in the case of a wound.

(5) Hectic fever. This, the last of the surgical fevers, occurs as a result of long-standing suppuration, and is most commonly seen in the case of chronic abscesses which have been opened and continue to discharge, and also in phthisis. It may best be regarded as a form of chronic blood-poisoning, arising from the absorption into the blood of small quantities of poisons derived from the germs which produce the suppuration.

Hectic fever is characterized by a gradual onset. The prominent symptoms in a well-marked case are the peculiar hectic temperature, which rises in the afternoon and falls in the early morning, loss of appetite and of flesh, and a quick pulse. The patient is usually pale, but there is a flush (hectic flush) on the cheeks. There is profuse sweating in the early morning, coincident with the fall of temperature. In the later stages diarrhœa, often of the most intractable type, is a distressing symptom. The patient gradually sinks from exhaustion.

We try to remove the source of suppuration, but this may be impossible. Often we can do nothing beyond relieving symptoms. The patient should sleep in flannel, so as to prevent being chilled by the copious perspiration. The diet should include an abundant supply of milk, also eggs and butter, when these can be digested. Cod-liver oil is commonly prescribed, rather as a food than a medicine. For the sweating,

belladonna, or its active ingredient atropine, is commonly used, also oxide of zinc. Tepid sponging is, however, sometimes sufficient to give relief. To control the diarrhœa opium may be required. Sulphate of copper in pill form is a favourite remedy, which may be combined with opium.

Erysipelas, popularly known as "the rose," is regarded by some as merely a severe inflammation of the skin ; but most authorities consider it to be due to a germ closely allied to those which are responsible for acute abscess formation. Erysipelas has come to be a widely used term, but it should be used to designate a severe infective inflammation of the skin which is unaccompanied by suppuration. It occurs as a bright red blush, with a sharply defined edge. It is liable to attack wounds, but may occur where there is no visible breach of the skin surface. Probably wounds on the scalp are those most commonly attacked, especially when

they occur in alcoholic subjects. Its contagious nature is shown by its liability to be spread by the hands, instruments, sponges, etc. It is possible that the disease may also be conveyed by the air. It is usually preceded by a rise of temperature for which no cause can be assigned, a general feeling of illness, and perhaps an attack of vomiting. It is apt to spread quickly, especially when loose tissues, such as those of the face, are attacked. There may be severe constitutional symptoms, such as headache, rapid pulse, delirium, and great exhaustion. The duration of the disease is uncertain ; it may last only a couple of days, or a fortnight or longer. The redness of the skin gradually fades away, and the swelling and stiffness of the affected part disappear. Erysipelas is seldom dangerous to life ; but when the head is attacked the outlook is more grave, for there is a risk of meningitis. Again, when occurring in the neighbourhood of the neck or face, the larynx

may become affected, and a severe form of laryngitis ensue, which may soon end fatally.

The treatment must be both preventive and curative. We must avoid over-crowding, especially in surgical wards. The disease has become much rarer since the adoption of the antiseptic treatment of wounds. Sponges, swabs, instruments, and hands must be rendered thoroughly aseptic. When a suspicious case of the disease arises, the patient must at once be isolated. In many of our larger hospitals an observation ward is set apart for cases such as these. No nurse who has attended to a case of even doubtful erysipelas must dress any other wounds. The bedding must be stoved, and disinfection carried out.

The curative treatment is both local and general. When there is a wound, it must be rendered as healthy as possible; it is almost sure to be septic. The inflamed skin is dusted with flour or zinc-and-starch powder, and

wrapped up in cotton-wool to exclude the air. In the case of the face a cotton-wool mask should be made. Small punctures or incisions may be required when there is much tension; this is, however, more likely to occur when the deeper tissues are involved. Tincture of iodine or a mixture of the tincture and liniment painted round the spreading margin sometimes limits the disease; it also has the advantage of being antiseptic.

As regards general treatment, a slop diet is ordered; stimulants are only prescribed in more severe cases, when the pulse is weak and rapid, and in old people. Champagne is often of great value in such cases, also brandy-and-egg mixture. The most commonly used drug in erysipelas is perchloride of iron (steel drops), given well diluted with water, to prevent irritation of the walls of the stomach. The mouth should be well washed out after taking it, to prevent any blackening of the teeth. Opium is

often required to relieve pain and procure sleep. A brisk purge is given at the commencement of the disease, such as Epsom salts or calomel. In the debilitated, and when convalescence is protracted, a favourite mixture employed is one containing sal volatile and bark (cinchona).

Tetanus, or lock-jaw, is a disease which we now know to be caused by a germ (a bacillus) which is often found in connexion with soil. It occurs generally in connexion with wounds, especially those into which soil has been admitted, and those which have become septic; but it frequently arises where there has been no apparent wound.

Tetanus may arise even in twenty-four hours after the production of a wound; it is rare after the tenth day. A feeling of stiffness about the jaws is first noticed; this gradually increases, and is presently accompanied by severe muscular spasms, which are aggravated by the slightest cause, such as the shutting of a door.



Poisoning by strychnine somewhat resembles this disease; but the spasms never entirely disappear in tetanus, as they do in strychnine poisoning, and they commence first of all in the muscles of the jaw in the former case, which gives the name (lock-jaw) to the disease.

The spasms increase in both severity and frequency, and eventually most of the muscles of the body become thus affected, and death occurs in nearly every case, most commonly from exhaustion. The jaws are tightly clenched, and the back is arched, so that the patient may during a paroxysm simply rest on the back of his head and his heels, the rest of the body being completely lifted off the bed.

In the management of this fatal disease many drugs have been recommended with a view to arresting or lessening the spasms, but none of them can be said to be of any great value. Chloroform inhalation gives relief while the



patient is under its influence, but the benefit can only be temporary.

Recently the serum treatment has been used in this disease with some measure of success ; for there are cases on record which have recovered under its use. Accordingly every case of tetanus should be treated by this measure, as affording by far the best chance of recovery that we possess. As in the case of other diseases treated by the serum method, to be of use recourse must be had to it at once. The preparation of the tetanus antitoxin is carried out in a manner allied to that adopted for the obtaining of diphtheria antitoxin (see Author's "Handbook for Nurses," p. 310). The room should be kept darkened and absolutely quiet, and every precaution taken to prevent any aggravation of the spasms.

Feeding by the nose will generally be found to increase the spasms ; and if nourishment cannot be given by the mouth, owing to the teeth being firmly clenched, recourse must

be had to nutrient enemata and suppositories.

Any wound must be treated on the principles already laid down. The nurse must devote her whole time to the patient, who should on no account be left; she must administer nourishment assiduously. Opium, bromide of potash, or chloral may be prescribed to procure rest; the last-named sometimes answers best given as an enema in a dose as large as forty grains.

Rabies (hydrophobia) is a disease which is intimately associated with the name of the late Louis Pasteur, who, by his well-known work, has done so much towards establishing a cure for this dreadful malady.

Rabies is caused by a poison which is usually introduced into the system by the saliva of a rabid animal, usually a dog, who snaps and bites at anyone or anything that crosses his path. A bite from a rabid animal is more likely to be followed by the disease when it is on a part of

the body, such as the face, which is unprotected by clothing, the clothes tending to protect the skin from the saliva. In cases of bites from rabid animals on an exposed part, 90 per cent. of those thus bitten develop the disease.

The symptoms consist in a sense of irritation about the wound, often long after its production, digestive troubles, and mental depression, followed in a few days by great excitement, with muscular spasm. Death generally occurs in from four to seven days, either from paralysis or from exhaustion.

We have to decide, in a suspicious case, whether the dog be mad or no ; and to ascertain this definitely the dog must be killed, and a post-mortem examination made by an expert. A rabid dog rushes about incoherently, and, as we have said, tends to snap at everything. He mopes about with his tail between his legs and his head hanging down.

Every dog-bite is best cauterized ; and in

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cases where it is decided that the animal inflicting the bite is rabid, the question has to be discussed concerning the adoption of Pasteur's treatment, which has hitherto necessitated a journey to Paris to the Pasteur Institute.

Briefly, Pasteur's treatment consists in the gradual acclimatization of the patient to the poison by carefully graduated doses of the poison of increasing strength, until the body, in due course of time, becomes protected. This line of treatment has met with much success in Pasteur's hands.

Delirium is a not uncommon symptom which may follow upon a severe wound. It is generally regarded as occurring in three different forms :—

(a) Active delirium of a restless type in a previously healthy full-blooded subject. The wound is usually septic. Commencing during the first two days it usually lasts a couple of days. It soon subsides with careful and tactful nursing and a sedative draught. The bowels should be

well opened and a light nourishing diet ordered. The wound will be carefully attended to and efforts made to cleanse and drain it.

(b) Delirium of a low muttering character may follow upon a wound occurring in patients of poor vitality, alcoholics, and those who have had insufficient food and who live under unhealthy conditions. The patient lies inert and incoherent, muttering and perhaps picking at his bed-clothes. He takes no notice of his surroundings. He passes his evacuations "under him". The mouth is kept open, the lips parched, and covered with crusts, and the tongue is dry and glazed. There is great muscular weakness and the pulse may be almost imperceptible. Here most careful nursing and feeding are necessary and stimulants are indicated.

(c) Delirium of a more violent type may be met with, especially in the intemperate, after such a severe injury as a compound fracture. After a night or two of sleeplessness delirium

sets in and gradually becomes more violent (delirium tremens). Horrible sights and sounds may be experienced, excitement is intense and the patient may attempt to jump out of bed or to do himself an injury or even commit suicide or murder. There are complete loss of appetite, muscular tremors and marked restlessness. The heart's action and the pulse may be feeble and constipation is usually present.

The stage of violence is followed by one of great exhaustion in which the patient may gradually lapse into unconsciousness and die.

Tremors and sleeplessness occurring in an alcoholic subject who has met with a severe wound are the precursors of this form of delirium.

The management of this complication will sometimes tax the nurse severely. Often a male attendant will be required. In our large hospitals it is customary to set apart a special ward for such cases.

The patient must on no account be left night

or day, and he must not be restrained by any mechanical means whatsoever. Any articles with which he might be able to damage himself or others must be carefully removed, such as razors, knives, and the like. In the vast majority of cases the medical man stops the drink entirely, and both doctor and nurse require to be firm, however much the patient may beg and crave for alcohol. There are two other important principles to be kept in mind: (1) To get food into the system by one means or another. If the stomach is so irritable that nourishment cannot be retained, as not uncommonly happens, then we must feed per rectum. Eggs, beef-tea, strong soups, milk, custards, and arrowroot are the chief articles to be selected. It is frequently necessary to peptonize foods, always in the case of rectal feeding. Nourishment must be given frequently. (2) To procure sleep. Bromide of potash or chloral, or, better still, a combination of the two (bromidia), is generally given



for this purpose. If we can fulfil these two requirements, the case is usually a hopeful one. People are, however, apt to die suddenly in the course of the disease; and all cases of delirium tremens must be regarded as serious.

A wound may be complicated by a fracture or a dislocation, that is to say the fracture or dislocation is compound. In a compound fracture the bone injury is the one which must in the first place be attended to. The bone and fragments may be only slightly displaced or may protrude through the wound. They may be splintered or covered with mud or other foreign matter. The two dangers to be met with in a compound fracture are hæmorrhage and sepsis, especially the latter, which may endanger life. We have seen how to deal with hæmorrhage. It must be remembered that in such an injury blood is apt to collect in the deeper parts of the wound. There may be death of some of the tissues (sloughing) and of



fragments of bone (necrosis). Again, septic inflammation of the bone may occur (septic osteomyelitis). Our object, then, is to reduce the fracture, getting the ends of the broken bone into as good a position as possible and then to render the wound aseptic, giving exit to discharges by efficient drainage. This may necessitate a counter-opening being made in the most dependent part. Antiseptics must be used freely. It is customary, nowadays, in such an injury, to fix the fragments in position by means of some mechanical device such as a plate and screws. The external wound is left open or closed as the surgeon thinks best. Dressings are applied and the limb placed on a suitable splint. The outlook depends on the severity of the injury and on the amount of damage done to the blood-vessels, nerves, and the soft parts generally. The neighbouring joint may be involved. This will still further complicate matters. The injury may be so serious as to demand amputation.

Compound dislocations are nearly always severe injuries, since the joint involved is exposed to all the risks of septic inflammation and, apart from this, there is almost sure to be serious damage done to blood-vessels and nerves.

Suppurative inflammation of the joint (septic arthritis) may follow and lead to subsequent stiffness or immobility (ankylosis) of the joint or to general septic poisoning and death. The dislocation is reduced and the wound made as aseptic as possible. If the head of the bone be much damaged it may be necessary to remove it, an excision of the joint being performed. Again, if the other structures are seriously damaged amputation may be called for. Free drainage, and dressing of the wound and fixation of the limb will be carried out as before.

A word about wounds, involving a joint apart from fracture or dislocation.

There may be an escape of an oily fluid with the blood, especially if the wound be considerable

in size. This is the synovia, the fluid which lubricates the joint. If the joint has not been infected a simple inflammation (synovitis) will follow ; but if germs have entered the joint then acute inflammation of the whole joint (arthritis) will occur which may lead to its destruction. If the wound is small and there be no reason to think that sepsis has occurred, the skin is thoroughly cleansed and an antiseptic dressing is applied and the condition of the joint and the temperature and pulse are carefully watched. As soon as any signs of further trouble arise, free incisions are made into the joint and the joint cavity is washed out. If the weapon causing the wound be a dirty one and it is almost certain that the joint has become infected, the wound is enlarged and carefully examined and if communication with the joint is proved the joint cavity is washed out and drained.

Finally, a few words must be said about

gangrene. This signifies death of a part *en masse* as distinguished from ulceration, by which we mean a disintegration of the superficial tissues without any actual sloughing. Ulceration and gangrene are, however, closely related, the former being a sort of microscopic death since it is not visible to the naked eye, whereas in sloughing and gangrene the dead tissue can be actually seen.

Gangrene may, of course, occur and frequently does occur apart from any wound. But we are only concerned with gangrene supervening on a wound as a complication. If the subject of the accident be intemperate or suffer from serious constitutional disease such as diabetes, Bright's disease or valvular heart disease he is naturally more liable to gangrene. Before gangrene actually takes place its onset is suspected when the vessels cease to pulsate and when the part becomes cold owing to loss of blood supply. At first severe pain is experienced, but when death

of the part has actually occurred, sensation is lost in the gangrenous part although pain may be and often is experienced in the adjoining tissues. If the limb be full of blood at the time gangrene occurs it will be purple and mottled ; if there be little or no blood in the affected part it will be pale and waxlike. The former state constitutes moist gangrene, the latter dry gangrene. It is with the former that we are here only concerned, since it is moist gangrene that follows upon a severe wound.

The consequent putrefaction of the dead part causes gases to be formed which produce a crackling when the part is handled. Moist gangrene is liable to follow upon a severe wound of the limb in which the main artery has been ruptured. In such a case there is a regurgitation of the blood in the veins into the capillaries and following upon this there is a development of germs in the affected tissues. Moist gangrene gives rise to severe constitutional



FIG. 10.—Septic moist gangrene of the leg.  
(From Rose and Corless Surgery.)



symptoms since it is almost always of a septic character. The patient suffers, in fact, from severe blood poisoning to which we have already referred in this chapter.

The general treatment of moist gangrene is that of sapræmia. The local treatment is (*a*) preventive and (*b*) curative. The former consists in using every effort to ward off gangrene in cases where it is to be feared, and to promote asepsis of the affected part and the whole limb. Apart from the actual treatment of the wound which we need not repeat, the whole limb in such a case should be thoroughly cleansed and purified; even the nails should be cut. The limb should then be enveloped in a sterile dressing—sterilized gamgee tissue answers well—and slightly raised in order to aid the venous circulation without obstructing the arterial flow. Such a dressing will also help to retain the heat in the limb. This may be promoted, too, by the free use of hot bottles, which must, however,

be carefully protected as it must be remembered that sensation may be blunted in a limb threatened with gangrene. If, in spite of all efforts, gangrene actually supervenes with its concomitant sepsis, amputation is called for, it may be as soon as the gangrene has ceased to extend, or, if it be spreading rapidly, without delay, at a considerable distance from the gangrenous area.











